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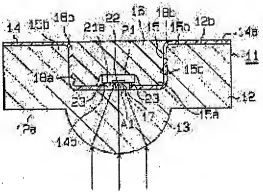
(54) OPTICAL DEVICE AND ITS FABRICATING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an optical device, and its fabricating method, in which heat resistance cycle can be enhanced.

SOLUTION: The optical device 11 comprises a light transmitting basic material part 12 and a chip 21. The basic material part 12 is formed of a material exhibiting higher heat resistance than epoxy resin. A lens part 13 is formed on the first face 12a of the basic material part 12. A conductor pattern 14 and a trench 15 are formed on the second face 12b of the basic material part 12. The chip 21 is surface mounted on the bottom face 15a of the trench 15. A light receiving part 22 is provided on the face 21a mounting the chip 21. The light receiving part 22 is directed toward the lens part 13.



Notes:
1. Untranslatable words are replaced with asterisks (****).
2. Texts in the figures are not translated and shown as it is.

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[Claim(s)]
[Claim 1] The base material part which has the light transmittance state by which the conductive pattern and crevice which have an electrode part are formed in the 2nd field while a lens part is formed in the 1st field, In Optical Devices Division equipped with the chip which has a light-emitting part or a light sensing portion in an installation side, and is accommodated in said crevice while a coefficient of thermal expansion forms said base material part with a small material rather than an epoxy resin without a filler Optical Devices Division characterized by carrying out surface mounting of said chip on the bottom of said crevice in the state where turned said installation side to said lens part side, and it has been arranged.
[Claim 2] Optical Devices Division according to claim 1 characterized by being filled up with the space produced between said installation side and said electrode part by the under philharmonic material which has a light transmittance state and insulation.
[Claim 3] The process which forms the conductive pattern which has an electrode part in said 2nd field in the base material for Optical Devices Division which equips the 1st field with the lens part arranged in the shape of a lattice, equips the 2nd field with two or more slots of a parallel relation mutually, and has a light transmittance state, By connecting the electrode and said electrode part of said chip electrically where the light-emitting part or light sensing portion of a chip is turned to the lens part side The manufacture method of Optical Devices Division characterized by including the process which carries out surface mounting of said chip, and the process which divides and piece[of **]-izes said base material for Optical Devices Division on the bottom of said slot.

[Detailed Description of the Invention]
[0001]

[Field of the Invention] This invention relates to Optical Devices Division and its manufacture methods, such as a photo-diode and Photographs IC and LED.

[0002]

[Description of the Prior Art] Various things are conventionally proposed as Optical Devices Division used for various control apparatus, such as a LED display for indication, optical-communications apparatus, an optical printer head, and a photosensor.

[0003] For example, Optical Devices Division 61 shown in drawing 11 is equipped with the base material part 62 and the lead frame 63. The base material part 62 is formed of the epoxy mold material for semiconductors (epoxy resin) which has a light transmittance state. The lens part 64 is formed in this base material part 62. Moreover, the chip 65 is mounted in the lead frame 63. The light sensing portion 66 is formed in the installation side 65a of this chip 65.

[0004] Moreover, Optical Devices Division 71 shown in drawing 12 is shown in JP,2000-164939,A. This Optical Devices Division 71 is equipped with the base material part 72 and the lead frame 73. The lens part 74 is formed in the base material part 72. Moreover, the chip 75 is mounted in the lead frame 73. The light-emitting part 76 is formed in the installation side 75a of the chip 75. The installation side 75a is arranged with the lens part 74 side in the counter direction. Moreover, the light reflector 77 is formed in Optical Devices Division 71. A light reflector 77 reflects the light from a light-emitting part 76, and sends it to the lens part 74.

[0005]

[Problem to be solved by the invention] However, in Optical Devices Division 61 shown in drawing 11 , when an epoxy resin was used for the base material part 62 and Optical Devices Division 61 encountered the heat cycle, the base material part 62 might change and the base material part 62 might exfoliate from the lead frame 63.

[0006] Moreover, in Optical Devices Division 71 shown in drawing 12 , the light reflector 77 needed to be formed in this Optical Devices Division 71. Therefore, while the structure of Optical Devices Division 71 will become complicated, there was a problem that the use efficiency of light will fall.

[0007] This invention is made in view of the above-mentioned technical problem, and the 1st purpose is to offer Optical Devices Division which can raise heat-resistant cycle nature, and its manufacture method. There is the 2nd purpose in offering Optical Devices Division which can raise the use efficiency of light, and its manufacture method while being able to simplify structure.

[0008]

[Means for solving problem] In order to attain the above-mentioned purpose, [invention according to claim 1] The base material part which has the light transmittance state by which the conductive pattern and crevice which have an electrode part are formed in the 2nd field while a lens part is formed in the 1st field, In Optical Devices Division equipped with the chip

which has a light-emitting part or a light sensing portion in an installation side, and is accommodated in said crevice while a coefficient of thermal expansion forms said base material part with a small material rather than an epoxy resin without a filler Let it be a summary to have carried out surface mounting of said chip on the bottom of said crevice in the state where turned said installation side to said lens part side, and it has been arranged.
[0009] Invention according to claim 2 makes it a summary to have been filled up with the space produced between said installation side and said electrode part by the under philharmonic material which has a light transmittance state and insulation in invention according to claim 1.
[0010] Invention according to claim 3 equips the 1st field with the lens part arranged in the shape of a lattice. The process which forms the conductive pattern which has an electrode part in said 2nd field in the base material for Optical Devices Division which equips the 2nd field with two or more slots of a parallel relation mutually, and has a light transmittance state, and where the light-emitting part or light sensing portion of a chip is turned to the lens part side Let it be a summary to include the process which carries out surface mounting of said chip, and the process which divides and piece[of **]-izes said base material for Optical Devices Division on the bottom of said slot by connecting the electrode and said electrode part of said chip electrically.
[0011] "OPERATION" of this invention is explained hereafter. According to invention according to claim 1, the amount of modification of the base material part according [the material used for a base material part] to a temperature change since the coefficient of thermal expansion is smaller than an epoxy resin without a filler becomes small. Therefore, it is prevented that a chip exfoliates from a base material part. Therefore, the heat-resistant cycle nature of Optical Devices Division can be raised. Moreover, the installation side is arranged towards the lens part side. Therefore, the light can pass through the field between an installation side and a lens part directly. It becomes unnecessary therefore, to prepare the composition for reflecting light independently. Therefore, the structure of Optical Devices Division can be simplified compared with the former. With it, the use efficiency of the light in Optical Devices Division can be raised.

[0012] According to invention according to claim 2, the under philharmonic material which has insulation is filled up with the space produced between an installation side and an electrode part. Therefore, it can prevent more certainly that a chip exfoliates from a base material part. Moreover, since under philharmonic material has a light transmittance state, light can pass through the field between an installation side and an electrode part certainly.
[0013] According to invention according to claim 3, since a crevice is a slot, it can carry out surface mounting of the chip easily. Moreover, since the lens part is arranged in the shape of a lattice, division of the base material for Optical Devices Division becomes easy. Therefore, two or more Optical Devices Division can be manufactured easily.

[0014]
[Mode for carrying out the invention] One embodiment of Optical Devices Division which materialized this invention, and its manufacture method is hereafter explained according to drawing 1 - drawing 9 .
[0015] As shown in drawing 1 - drawing 3 , Optical Devices Division 11 is equipped with the base material part 12 formed in the shape of an abbreviation rectangular parallelepiped of the material which has a light transmittance state. As shown in drawing 1 (b), the abbreviation hemisphere-like lens part 13 is really formed in the center section in the 1st field 12a of the base material part 12. Moreover, as shown in drawing 1 (a), the slot 15 as a crevice is established in a part for the central part in the 2nd field 12b of the base material part 12. As shown in drawing 2 and drawing 3 , the bottom 15a of the slot 15 is flat. The 1st a. side 18a connects between Bottom 15a and the inner wall surface 15c. With it, the 2nd a. side 18b as a curved surface which connects the 2nd Field 12b and inner wall surface 15c is established in the opening edge part 15b of the slot 15.
[0016] Moreover, printing formation of the conductive pattern 14 which has an electrode part is carried out at the 2nd field 12b side of the base material part 12. The pad 14a for external connection as an electrode part is formed in the end of the conductive pattern 14. The pad 14b for chip connection as an electrode part is formed in the other end of the conductive pattern 14. Each pad 14a for external connection is formed on the 2nd field 12b. Each pad 14a for external connection of each other is symmetrically arranged through the slot 15. The width of each pad 14a for external connection is equal, respectively. Moreover, the pad 14b for chip connection is formed on Bottom 15a.
[0017] As shown in drawing 3 , the mold part 16 is formed in the slot 15. The mold part 16 is formed by being filled up with semiconductor epoxy mold material in a slot 15.
[0018] Said base material part 12 is formed of the material whose coefficient of thermal expansion is smaller than an epoxy resin without a filler. Here, the coefficients of thermal expansion of an epoxy resin without a filler are 60x10-6/degree C - 70x10-6/degree C. In addition, in this embodiment, the base material part 12 is formed with the glass whose coefficients of thermal expansion are 0.5x10-6/degree C - 10x10-6/degree C.
[0019] As shown in drawing 2 and drawing 3 , the abbreviation rectangular parallelepiped-like chip 21 is accommodated in the slot 15. Will be stuck to the field by the side of opposite [of the installation side 21a in a chip 21] by the mold part 16. A chip 21 is protected from external force, dust, water, etc. by carrying out a mold to the mold part 16. Two or more bumps 23 protrude on the perimeter part in the installation side 21a of this chip 21. Each bump 23 is stationed so that it may correspond to the pad 14b for chip connection. Surface mounting of the chip 21 is carried out on Bottom 15a by connecting electrically a bump 23 and the pad 14b for chip connection. The closure part 17 is formed in the space A1 produced between the

installation side 21a and Bottom 15a by filling up with the under philharmonic material which has a light transmittance state. This closure part 17 has covered the bump 23. In addition, in this embodiment, silicone gel is used as a under philharmonic material. Moreover, the light sensing portion 22 is formed in the central part of the installation side 21a of a chip 21. The light sensing portion 22 is arranged towards the lens part 13 side. The center of the light sensing portion 22 is arranged so that it may be in agreement with the optic axis of the lens part 13.

[0020] Next, the base material 41 for Optical Devices Division used when manufacturing Optical Devices Division 11 is explained. As shown in drawing 4 and drawing 5 , the base material 41 for Optical Devices Division is formed in tabular of the material which has a light transmittance state. As shown in drawing 4 , the lens part [two or more (this embodiment 24 pieces)] 13 is arranged in the shape of a lattice in the 1st field 41a of the base material 41 for Optical Devices Division. Moreover, as shown in drawing 5 , two or more conductive patterns (this embodiment 12) 14 are formed in the 2nd field 41b of the base material 41 for Optical Devices Division. With it, the slot 15 of two or more rows (this embodiment four rows) is established in the 2nd field 41b of the base material 41 for Optical Devices Division. The slot 15 lies at right angles to the longitudinal direction of the conductive pattern 14. Each slot 15 is arranged mutually at the parallel relation. Two or more base material parts 12 are simultaneously formed by dividing this base material 41 for Optical Devices Division in the one-point chain line shown in drawing 5 .

[0021] Next, the manufacture method of Optical Devices Division 11 is explained. First, in the base material 41 for Optical Devices Division, a mask 51 is covered to the 2nd field 41b. By etching in this state, as shown in drawing 6 , the slot 15 which has the 1st a. side 18a is formed. And some masks 51 51a are removed and it etches again. As a result, as shown in drawing 7 , the opening edge part 15b of a slot 15 becomes the 2nd a. side 18b, and formation of the conductive pattern 14 becomes easy. And after removing a mask 51 altogether, printing formation of the conductive pattern 14 is carried out at the base material 41 for Optical Devices Division.

[0022] Next, as shown in drawing 8 , where the light sensing portion 22 of a chip 21 is turned to the lens part 13 side, the bump 23 and the conductive pattern 14 of a chip 21 are connected electrically. Surface mounting of the chip 21 is carried out on the bottom 15a of a slot 15 by it. And the closure part 17 is formed by closing a chip 21 with under philharmonic material. Furthermore, the mold part 16 is formed by filling up a slot 15 with semiconductor epoxy mold material.

[0023] Then, as shown in drawing 9 , the base material 41 for Optical Devices Division is divided in the part of the one-point chain line which makes the shape of the squares. Speaking concretely, this base material 41 for Optical Devices Division being in the state where the

blade with which the dicing saw was equipped was rotated, and dividing it by moving this blade along with an one-point chain line. As a result, the base material 41 for Optical Devices Division of one sheet is piece[of **]-ized by two or more Optical Devices Division 11. Therefore, two or more Optical Devices Division 11 is manufactured simultaneously.

[0024] According to this embodiment, the following effects can be acquired.

(1) The material used for the base material part 12 is a material whose coefficient of thermal expansion is smaller than an epoxy resin without a filler. Therefore, it becomes difficult to generate heat stress and the amount of modification of the base material part 12 by a temperature change becomes small. Therefore, it is prevented that a chip 21 exfoliates from the base material part 12. Therefore, the heat-resistant cycle nature of Optical Devices Division 11 can be raised. Moreover, the installation side 21a is arranged towards the lens part 13 side. Therefore, the light can pass through the field between the installation side 21a and the lens part 13 directly. It becomes unnecessary therefore, to prepare the composition for reflecting light independently. Therefore, the structure of Optical Devices Division 11 can be simplified compared with the former. Moreover, the distance which light passes compared with the former is shortened. Therefore, loss of the light by a reflection, diffusion, etc. becomes small. Therefore, the use efficiency of the light in Optical Devices Division 11 can be raised.

[0025] (2) The under philharmonic material which has insulation is filled up with the space A1 produced between the installation side 21a and the conductive pattern 14. Therefore, it can prevent more certainly that a chip 21 exfoliates from the base material part 12. Moreover, since under philharmonic material has a light transmittance state, light passes through the field between the installation side 21a and the conductive pattern 14 certainly. Therefore, it is not necessary to pass light in the mold part 16. Therefore, the material in particular used for the mold part 16 does not need to have a light transmittance state. Therefore, the material used for the mold part 16 can be chosen freely.

[0026] (3) The crevice prepared in the base material 41 for Optical Devices Division is a slot 15. Therefore, the space for inserting the tool for attaching a chip 21 in a slot 15 at the time of attachment of a chip 21 is secured. Therefore, surface mounting of the chip 21 can be carried out easily. Moreover, since the lens part 13 is arranged in the shape of a lattice, division of the base material 41 for Optical Devices Division becomes easy. Therefore, two or more Optical Devices Division 11 can be manufactured easily.

[0027] (4) Use the high silicone gel of the light transmittance state by this embodiment as a under philharmonic material which forms the closure part 17. Therefore, when light passes the closure part 17, it can prevent that loss of light becomes large by diffusion etc. Therefore, it can prevent that the use efficiency of the light which passes through the inside of Optical Devices Division 11 falls.

[0028] (5) The mold part 16 is formed by filling up a slot 15 with the epoxy mold material for

semiconductors. Therefore, a chip 21 can be certainly protected from external force, dust, water, etc.

[0029] (6) The base material part 12 containing the lens part 13 is formed by methods other than mold fabrication by being made from glass. Therefore, unlike the case where the base material part 12 is formed by the epoxy mold material for semiconductors like before, it can prevent that air bubbles and a cavity occur in the lens part 13. Moreover, unlike the conventional epoxy mold material for semiconductors, it can prevent that a yellow-ized phenomenon occurs in the lens part 13.

[0030] (7) The 2nd a. side 18b which connects the 2nd Field 12b and inner wall surface 15c is established in the opening edge part 15b of the slot 15. Therefore, the adhesion nature of the conductive pattern 14 to the 2nd a. side 18b improves. Therefore, even if it forms the conductive pattern 14, a possibility that this conductive pattern 14 will separate becomes small. Therefore, the conductive pattern 14 can be formed certainly.

[0031] In addition, you may change this embodiment as follows. - In the aforementioned embodiment, the base material part 12 was formed with glass. However, it has a light transmittance state and the base material part 12 may be formed by the resin material whose coefficient of thermal expansion in a state without a filler is smaller than an epoxy resin. For example, you may form the base material part 12 using polycarbonate resin, silicone resin, etc.

[0032] - In the aforementioned embodiment, the bottom 15a of the slot 15 was flat. However, you may change the cross-sectional form of a slot 15. For example, you may make a slot 15 into other form, such as the shape of a cross-sectional semicircle. Thus, if constituted, the function of the lens part 13 can be given to a slot 15. Therefore, even if it omits the lens part 13, the desired **** characteristic can be acquired with the form of a slot 15.

[0033] - In the aforementioned embodiment, the silicone gel which has a light transmittance state was used as a under philharmonic material which forms the closure part 17. However, you may use what has the light transmittance state of an epoxy resin, phenol resin, an acrylic resin, methacrylic resin, water glass, etc. as a under philharmonic material instead of silicone gel.

[0034] - In the aforementioned embodiment, the width of each pad 14a for external connection had become the same size, respectively. However, the width of each pad 14a for external connection may differ, respectively. Thus, if constituted, it can prevent being incorrect-equipped with a chip 21 in a slot 15.

[0035] - In the aforementioned embodiment, printing formation of the conductive pattern 14 was carried out in the 2nd field 12b. However, you may form the conductive pattern 14 in the 2nd field 12b by other methods, such as vapor deposition.

[0036] - In the aforementioned embodiment, the mold part 16 was formed of the epoxy resin.

Instead, you may form the mold part 16 by other material, such as synthetic resins, such as urea resin, a fluoro-resin, or polycarbonate resin, and silicone rubber.
[0037] - As shown in drawing 10 (a) and drawing 10 (b), you may protrude the positioning parts 31a and 31b on the mold part 16. Thus, if constituted, the positioning accuracy of Optical Devices Division 11 can be raised at the time of use of Optical Devices Division 11.
[0038] - Optical Devices Division 11 as a light-receiving object consisted of aforementioned embodiments by forming a light sensing portion 22 in the installation side 21a of a chip 21. However, you may form Optical Devices Division 11 as a photogen by forming a light-emitting part in the installation side 21a of a chip 21. Moreover, you may form Optical Devices Division 11 as a light-receiving-and-light-emitting object by forming both a light sensing portion 22 and a light-emitting part in the installation side 21a of a chip 21.
[0039] - You may arrange two or more chips 21 on the bottom 15a of a slot 15. Thus, if constituted, a chip 21 can be made to be able to become independent, respectively and can be made to drive. Therefore, two or more functions can be given to one Optical Devices Division 11.
[0040] Next, the technical idea grasped by the embodiment mentioned above is indicated below besides the technical idea indicated to Claims.
(1) Optical Devices Division characterized by forming a mold part in Claim 1 or 2 by filling up the inside of said crevice with the epoxy mold material for semiconductors. Therefore, according to the technical idea (1), a chip can be protected certainly.
[0041] (2) Optical Devices Division characterized by protruding a positioning part on said mold part in a technical idea (1). Therefore, according to the technical idea (2), the positioning accuracy of Optical Devices Division can be raised.
[0042] (3) Optical Devices Division characterized by forming said base material part with glass in Claim 1 or 2, and technical idea (1) - (2). Therefore, according to the technical idea (3), it can prevent that air bubbles and a cavity occur in base material circles.
[0043] (4) Optical Devices Division characterized by making the bottom of said crevice flat in Claim 1 or 2, and technical idea (1) - (3).
(5) Optical Devices Division characterized by the width of each of said electrode part differing, respectively in Claim 1 or 2, and technical idea (1) - (4). Therefore, according to the technical idea (5), it can prevent being incorrect-equipped with a chip in a crevice.
[0044] (6) Optical Devices Division characterized by preparing the curved surface which connects said 2nd field and the inner wall surface of said crevice with the opening edge part of said crevice in Claim 1 or 2, and technical idea (1) - (5). Therefore, according to the technical idea (6), an electrode part can be formed certainly.
[0045] (7) The lens part arranged in the shape of a lattice in the 1st field, the base material for Optical Devices Division characterized by enabling it to form two or more Optical Devices

Division in the 2nd field simultaneously an electrode part and by forming two or more slots of a parallel relation mutually. Therefore, according to the technical idea (7), since two or more Optical Devices Division was formed in one base material for Optical Devices Division, an electrode part can be formed at once.

[0046] (8) where it formed the electrode part in the base material for Optical Devices Division which has a light transmittance state and the light-emitting part or light sensing portion of a chip is turned to the lens part side The manufacture method of Optical Devices Division characterized by dividing said base material for Optical Devices Division after carrying out surface mounting of said chip by connecting the electrode and said electrode part of said chip electrically at said base material for Optical Devices Division.

[0047]

[Effect of the Invention] As explained in full detail above, according to invention according to claim 1, the heat-resistant cycle nature of Optical Devices Division can be raised. Moreover, the structure of Optical Devices Division can be simplified compared with the former. With it, the use efficiency of the light in Optical Devices Division can be raised.

[0048] According to invention according to claim 2, it can prevent more certainly that a chip exfoliates from a base material part. Moreover, light can pass through the field between an installation side and an electrode part certainly.

[0049] According to invention according to claim 3, two or more Optical Devices Division can be manufactured easily.

[Brief Description of the Drawings]

[Drawing 1] As for (a), the perspective view showing Optical Devices Division seen from the 2nd field side in this embodiment and (b) are the perspective views showing Optical Devices Division seen from the 1st field side similarly.

[Drawing 2] The important section enlarged drawing of Optical Devices Division.

[Drawing 3] The sectional view in three to 3 line of drawing 1 .

[Drawing 4] The perspective view showing the 1st [of the base material for Optical Devices Division] field side.

[Drawing 5] The perspective view showing the 2nd [of the base material for Optical Devices Division] field side.

[Drawing 6] The sectional view showing the state in the middle of the 2nd [of the base material for Optical Devices Division] field side being etched.

[Drawing 7] The sectional view in seven to 7 line of drawing 5 .

[Drawing 8] The sectional view of the base material for Optical Devices Division in which the

state after the chip was attached is shown.

[Drawing 9] The perspective view showing the 2nd [of the base material for Optical Devices Division in which the state before being divided is shown] field side.

[Drawing 10] (a) And (b) is the perspective view showing Optical Devices Division in example of another.

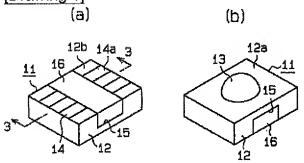
[Drawing 11] The sectional view of Optical Devices Division in the conventional technology.

[Drawing 12] The sectional view of Optical Devices Division in the conventional technology.

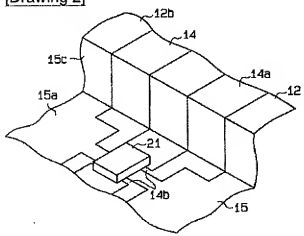
[Explanations of letters or numerals]

11 [-- The 2nd field,] -- Optical Devices Division, 12 -- A base material part, 12a -- The 1st field, 12b 13 -- A lens part, 14 -- A conductive pattern, 14a -- The pad for external connection as an electrode part, 14b [-- A chip, 21a / -- An installation side, 22 / -- A light sensing portion, 23 / -- The bump as an electrode, 41 / -- The base material for Optical Devices Division, A1 / -- Space.] -- The pad for chip connection as an electrode part, 15 -- The slot as a crevice, 15a -- The bottom, 21

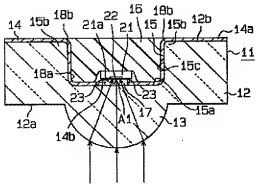
[Drawing 1]



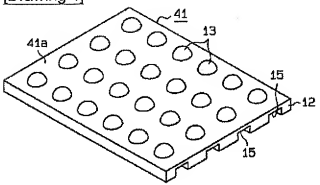
[Drawing 2]



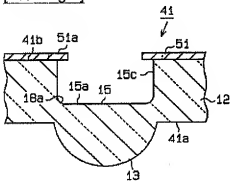
[Drawing 3]



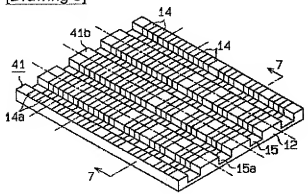
[Drawing 4]



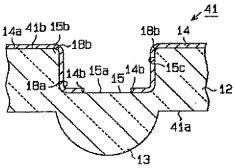
[Drawing 6]



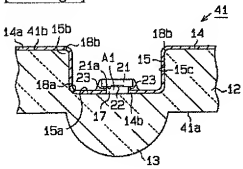
[Drawing 5]



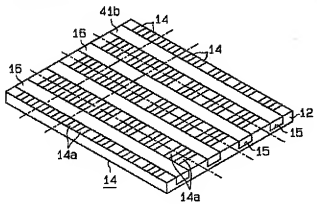
[Drawing 7]



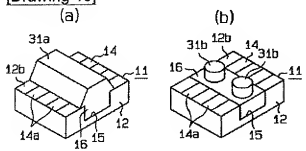
[Drawing 8]



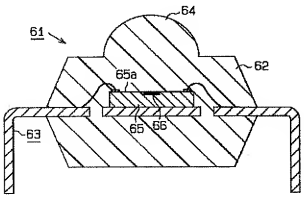
[Drawing 9]



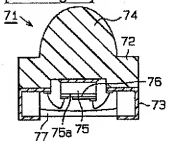
[Drawing 10]



[Drawing 11]



[Drawing 12]



[Translation done.]